

**Spring Creek Embayment  
Wheeler Reservoir  
Intensive Basin Survey 2015**

**WHEL-9:** Spring Creek approx 0.5 mi upstream of CR400 bridge (Lawrence Co 34.72263/-87.28049)

**BACKGROUND**

The Alabama Department of Environmental Management (ADEM) began monitoring lake water quality statewide in 1985, followed by a second statewide survey in 1989. In 1990, the Reservoir Water Quality Monitoring Program [now known as the Rivers and Reservoirs Monitoring Program (RRMP)] was initiated by ADEM.

The current objectives of this program are to provide data that can be used to assess current water quality conditions, identify trends in water quality conditions and to develop Total Maximum Daily Loads (TMDLs) and water quality criteria. Descriptions of all RRMP monitoring activities are available in ADEM’s 2012 Monitoring Strategy (ADEM 2012).

In 2015, ADEM monitored the Spring Creek tributary embayment of Wheeler Reservoir as part of the basin assessment of the Tennessee River under the RRMP. This site was selected using historical data and previous assessments. The purpose of this report is to summarize data collected in the Spring Creek embayment (WHEL-9) during the 2015 growing season (Apr-Oct). This is the fourth basin assessment of the Tennessee River since ADEM began sampling. Monthly and/or mean concentrations of nutrients [total nitrogen (TN); total phosphorus (TP)], algal biomass/productivity [chlorophyll *a* (chl *a*); algal growth potential testing (AGPT)], sediment [total suspended solids (TSS)], and trophic state [Carlson’s trophic state index (TSI)] from 2015 were compared to ADEM’s historical data and established criteria.

**WATERSHED CHARACTERISTICS**

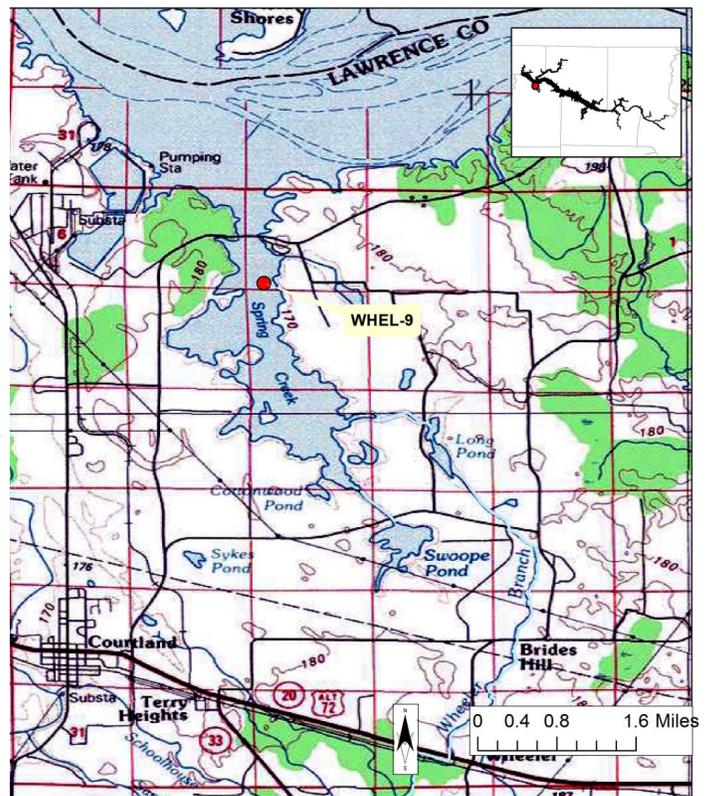
Watershed land uses are summarized in Table 1. Spring Creek is classified as a *Public Water Supply/Swimming/Fish & Wildlife (PWS/SF&W)* stream located in the Eastern Highland Rim ecoregion (71g). Based on the 2006 National Land Cover Dataset, land use within the small 18 mi<sup>2</sup> watershed is predominantly cultivated crops (52%) (Fig. 3). As of January 28, 2016, ADEM has issued no NPDES permits within the watershed (Fig. 2).

**SITE DESCRIPTION**

The Spring Creek embayment at WHEL-9 is located near the community of Courtland, AL, halfway between Florence and Decatur. It is a narrow, deep embayment which flows into the Tennessee River near river mile 283. Spring Creek has a mean bottom depth of 9.05 m (Table 2) at the sampling location and is fairly clear most of the year.



**Figure 1.** Photo of Spring Creek at WHEL-9.



**Figure 2.** Map of Spring Creek embayment of Wheeler Reservoir. No permitted discharges exist within this watershed.

## METHODS

Water quality assessments were conducted at monthly intervals, April-October. All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2015), Surface Water Quality Assurance Project Plan (ADEM 2012), and Quality Management Plan (ADEM 2013).

Mean growing season TN, TP, chl *a*, and TSS were calculated to evaluate water quality conditions. Monthly concentrations of these parameters were graphed with ADEM's previously collected data to help interpret the 2015 results. Carlson's TSI was calculated from the corrected chl *a* concentrations.

## RESULTS

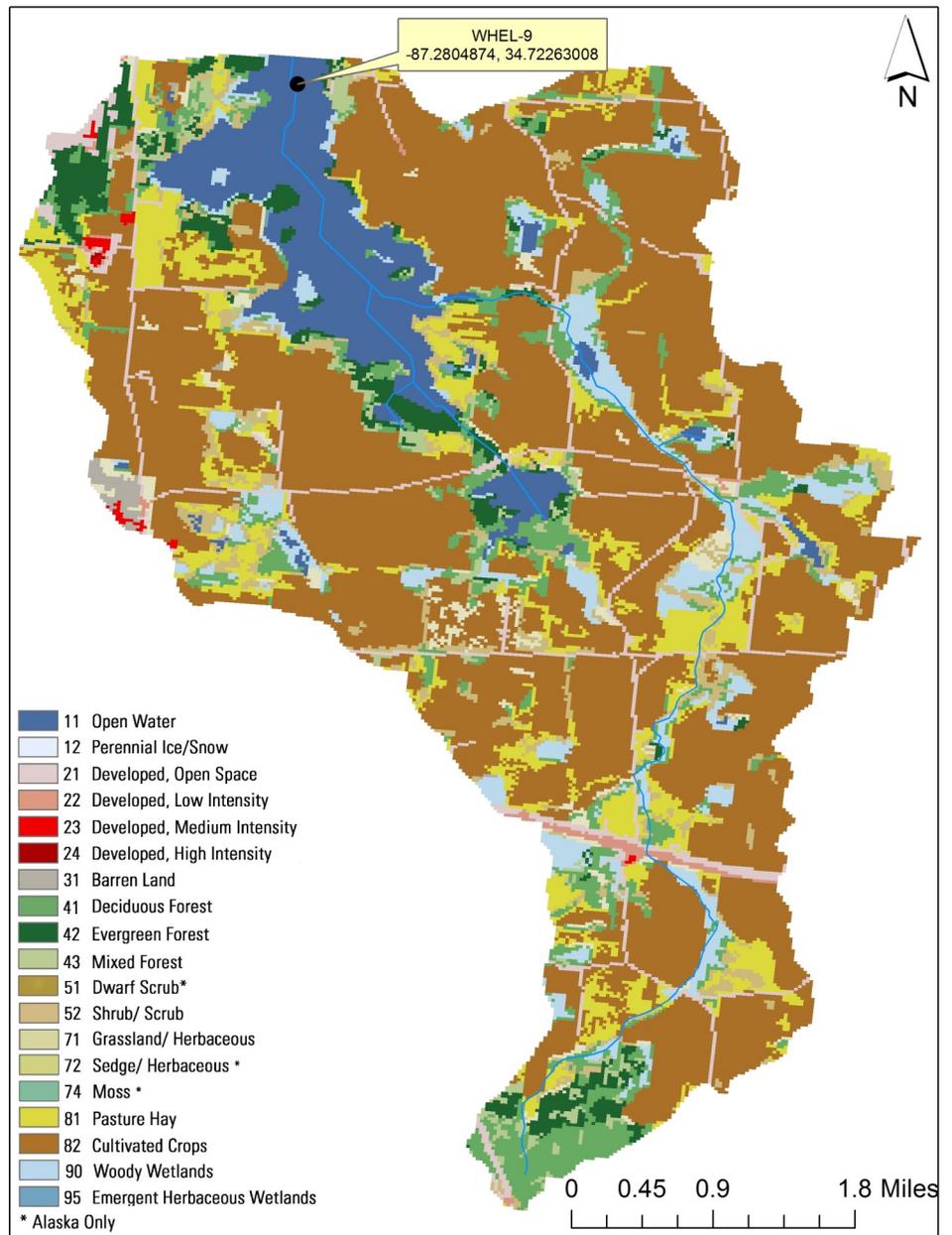
The following discussion of results is limited to those parameters which directly affect trophic status or parameters which have established criteria. Results of all water chemistry analyses are presented in Table 2. The axis ranges of the graphs in Figs. 4-6 were set to maximum values reservoir wide so all embayment reports on the same reservoir could be compared.

**Table 1: Summary of Watershed WHEL-9**

Basin		Tennessee R
Drainage Area (mi <sup>2</sup> )		18
Ecoregion <sup>a</sup>		71g
% Land use		
Open Water		8%
Developed	Open Space	4%
	Low Intensity	<1%
	Medium Intensity	<1%
	High Intensity	<1%
Barren Land		<1%
Forest	Deciduous Forest	7%
	Evergreen Forest	4%
	Mixed Forest	2%
Shrub/Scrub		5%
Herbaceous		2%
Hay/Pasture		10%
Cultivated Crops		52%
Wetlands	Woody	5%
	Emergent Herb.	<1%
# NPDES outfalls <sup>b</sup>		TOTAL 0

a. Eastern Highland Rim

b. #NPDES outfalls downloaded from ADEM's NPDES Management System database, Jan 28, 2016.



**Figure 3.** Landuse within the Spring Creek watershed at WHEL-9.

The mean growing season TN value increased from 2003 through 2013 then declined slightly in 2015 (Fig. 4). Monthly TN concentrations were highest in April.

Mean growing season TP concentrations have steadily declined since 2003 (Fig. 4). Mean values in 2015 were 1/3 of those measured in 2003. Monthly TP concentrations were low and varied little throughout the growing season.

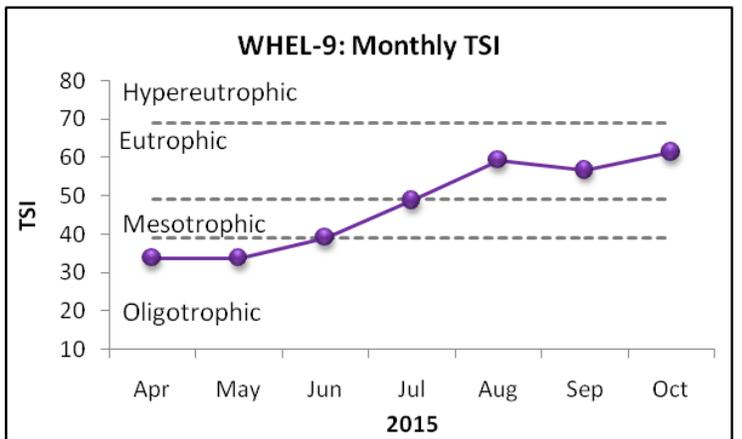
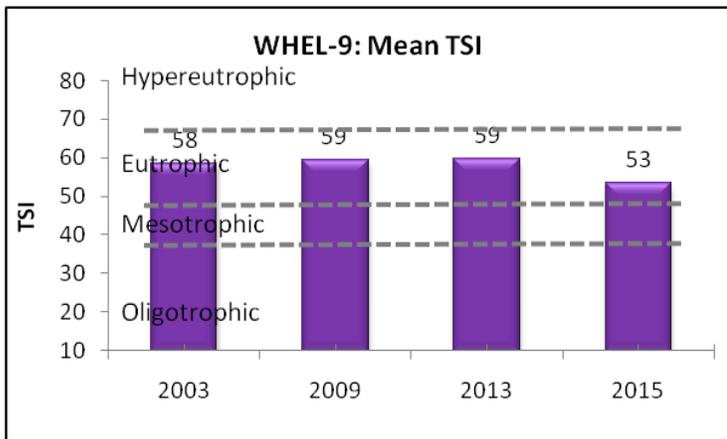
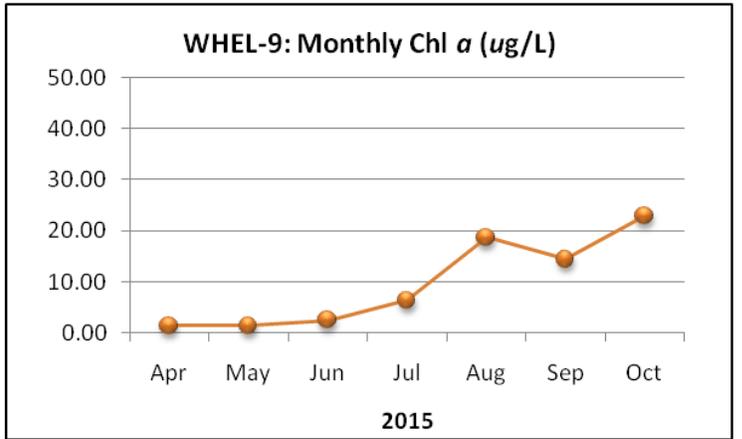
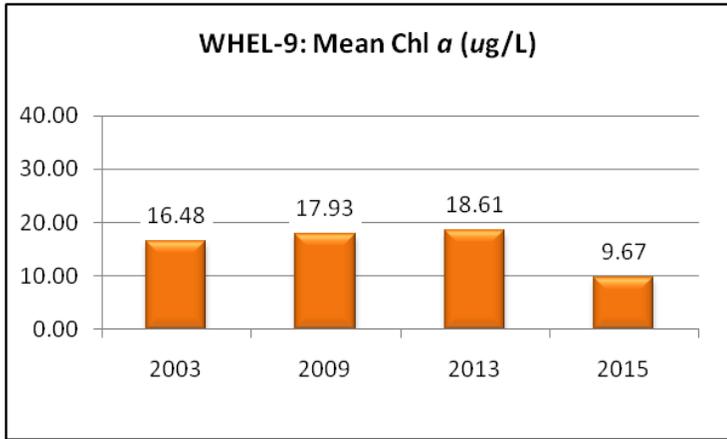
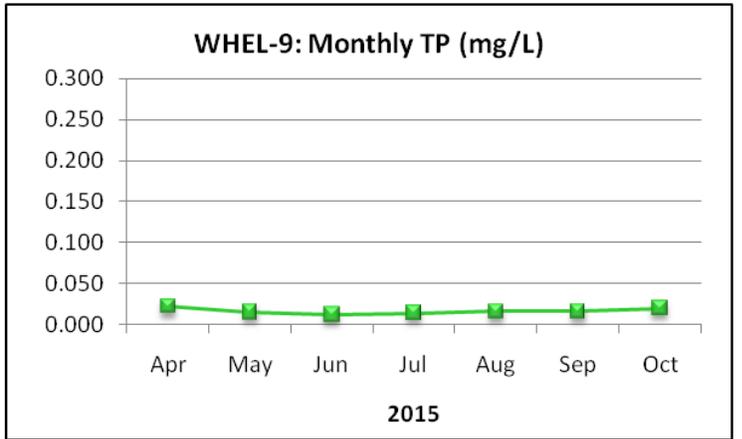
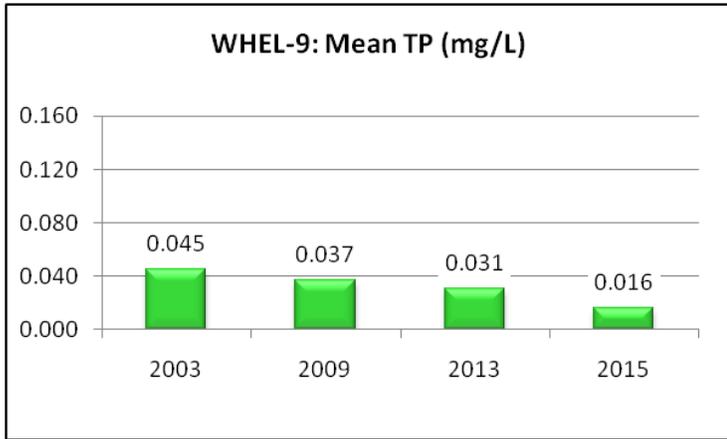
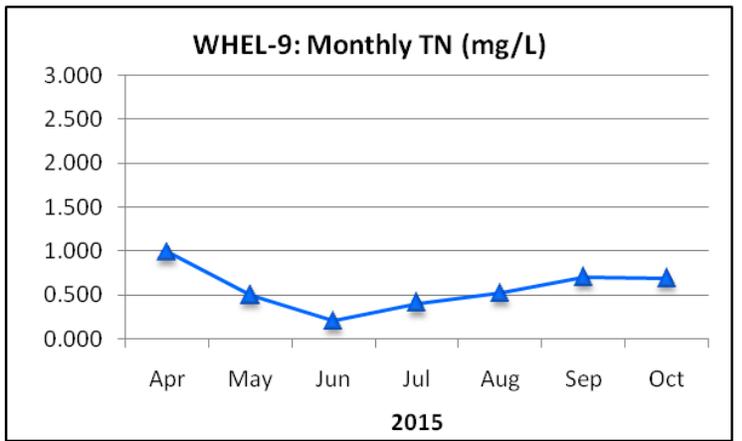
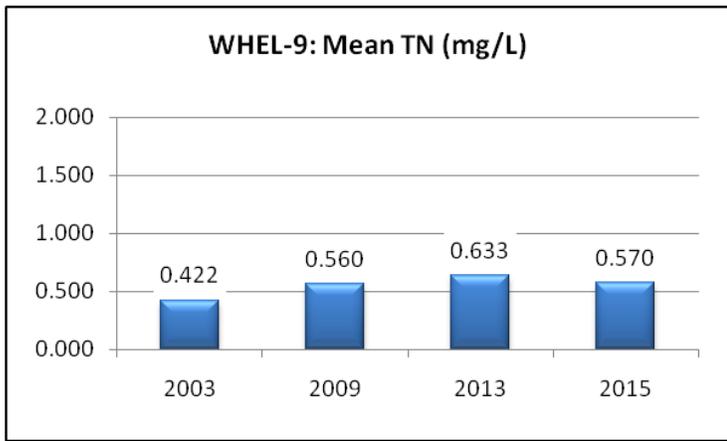
The mean growing season chl *a* value increased from 2003 through 2013 then declined in 2015 (Fig. 4). Monthly chl *a* concentrations generally increased throughout the growing season with the highest concentrations measured in October.

Mean TSI values have remained eutrophic all years monitored. Monthly TSI in Spring Creek was eutrophic August-October (Fig. 4).

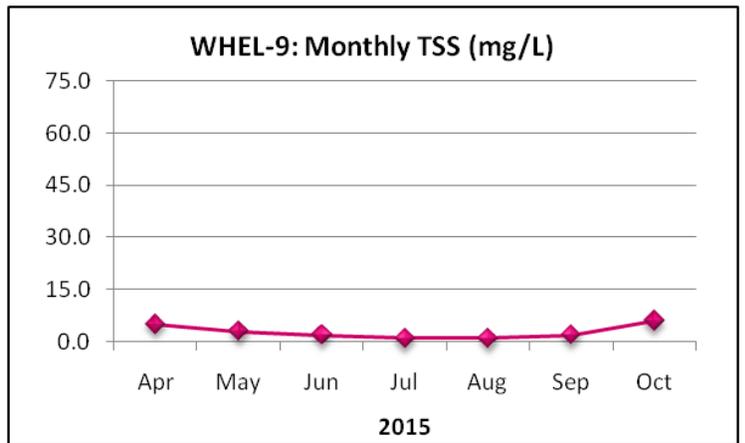
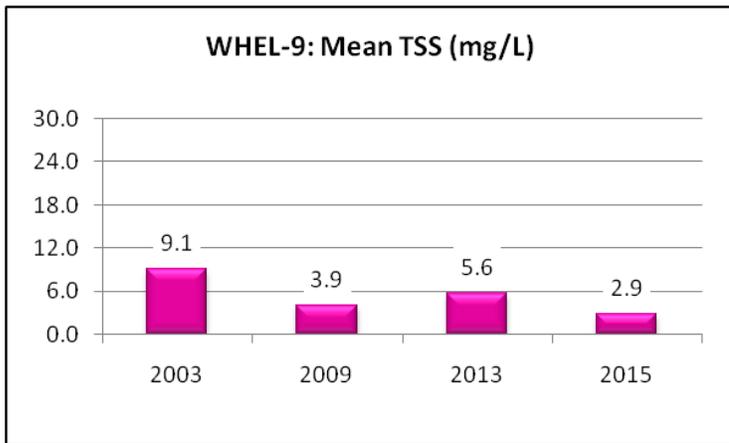
Mean growing season TSS values have generally declined since monitoring began (Fig. 5). Monthly TSS concentrations varied little throughout the growing season.

No AGPT sample was collected from Spring Creek in 2015. Results from 2003-2013 are shown in Table 3.

DO concentrations in the WHEL-9 station remained above the ADEM criteria limit (ADEM Admin. Code R. 335-6-10-.09) of 5.0 mg/L at 5.0 ft (1.5 m) April through October (Fig. 6).



**Figure 4.** Mean growing season (2003-2015) and monthly (April-October, 2015) TN, TP, chl a and TSI measured in the Spring Creek embayment of Wheeler Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.



**Figure 5.** Mean growing season and monthly TSS measured in the Spring Creek embayment of Wheeler Reservoir.

**Table 2.** Summary of water quality data collected April-October, 2015. Minimum (Min) and maximum (Max) values calculated using minimum detection limits. Median (Med), mean, and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

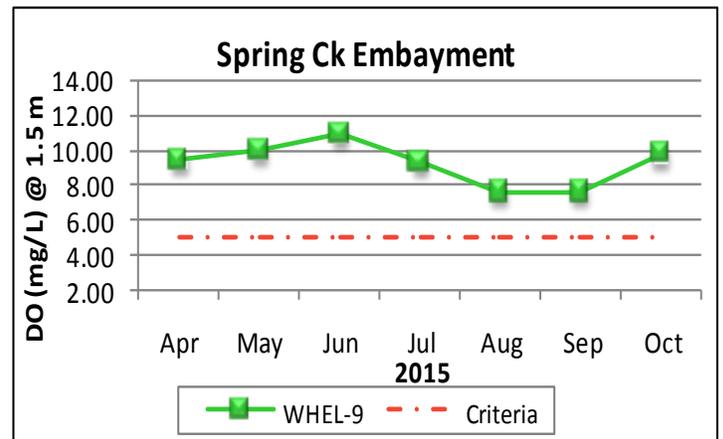
WHEL-9	N	Min	Max	Med	Mean	SD
<b>Physical</b>						
Turbidity (NTU)	7	2.8	6.3	3.7	3.9	1.2
Total Dissolved Solids (mg/L)	7	91.0	123.0	105.0	105.4	11.6
Total Suspended Solids (mg/L)	7	1.0	6.0	2.0	2.9	2.0
Hardness (mg/L)	4	75.7	92.1	89.4	86.6	7.7
Alkalinity (mg/L)	7	69.0	91.1	78.0	79.6	8.2
Photic Zone (m)	7	3.55	6.11	5.39	5.13	0.82
Secchi (m)	7	1.13	2.34	1.73	1.73	0.40
Bottom Depth (m)	7	8.00	9.60	9.00	9.05	0.57
<b>Chemical</b>						
Ammonia Nitrogen (mg/L)	7	< 0.010	0.041	0.030	0.025	0.016
Nitrate+Nitrite Nitrogen (mg/L) <sup>J</sup>	7	< 0.002	0.600	0.018	0.147	0.238
Total Kjeldahl Nitrogen (mg/L) <sup>J</sup>	7	0.135	0.697	0.402	0.423	0.224
Total Nitrogen (mg/L) <sup>J</sup>	7	< 0.199	0.987	0.517	0.570	0.252
Dissolved Reactive Phosphorus (mg/L) <sup>J</sup>	7	< 0.002	0.004	0.002	0.002	0.001
Total Phosphorus (mg/L)	7	0.012	0.022	0.016	0.016	0.004
CBOD-5 (mg/L) <sup>J</sup>	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	5.3	7.6	6.6	6.4	0.9
<b>Biological</b>						
Chlorophyll a (ug/L)	7	1.40	23.00	6.41	9.67	8.96
E. coli (col/100mL) <sup>J</sup>	3	< 1	1	1	1	0

J= one or more of the values is an estimate; N=# samples.

**Table 3.** Algal growth potential test results (expressed as mean MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes (Raschke and Schultz 1987).

WHEL-9	MSC	Limiting Nutrient
8/20/2003	2.24	CO-LIMITING
8/18/2009	2.37	CO-LIMITING
8/20/2013	7.71	NITROGEN

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**Figure 6.** Monthly DO concentrations at 1.5 m (5 ft) for Spring Creek embayment station of Wheeler Reservoir collected April-October 2015. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

## REFERENCES

- ADEM. 2015. Standard Operating Procedures Series #2000, Alabama Department of Environmental Management (ADEM), Montgomery, AL.
- ADEM. 2013. Quality Management Plan (QMP) for the Alabama Department of Environmental, Alabama Department of Environmental Management (ADEM), Montgomery, AL. 58 pp.
- ADEM. 2012. Quality Assurance Project Plan (QAPP) for Surface Water Quality Monitoring in Alabama. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 78 pp.
- ADEM. 2012. State of Alabama Water Quality Monitoring Strategy June 19, 2012. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 88 pp. <http://www.adem.alabama.gov/programs/water/wqsurvey/2012WQMonitoringStrategy>
- Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.09). 2010. Specific Water Quality Criteria. Water Quality Program. Chapter 10. Volume 1. Division 335-6.
- Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.11). 2010. Water Quality Criteria Applicable to Specific Lakes. Water Quality Program. Chapter 10. Volume 1. Division 335-6.
- Carlson, R.E. 1977. A trophic state index. *Limnology and Oceanography*. 22(2):361-369.
- Raschke, R.L. and D.A. Schultz. 1987. The use of the algal growth potential test for data assessment. *Journal of Water Pollution Control Federation* 59(4):222-227.